

# Applications of Electroporation in Veterinary Medicine

## Introduction & Fundamentals of Electroporation

Electroporation (EP) is a phenomenon resulting from applying a strong, albeit short, electrical pulse to any cell or tissue, which causes the formation of temporary “pores” in the plasma membrane. These openings allow molecules that normally cross the membrane only in minute amounts to readily pass through the barrier in quantity (Fig. 1). This bibliographic review takes a glance at how it works, giving a practical point of view on its most remarkable applications in veterinary medicine. It also introduces the available devices for animal practice.

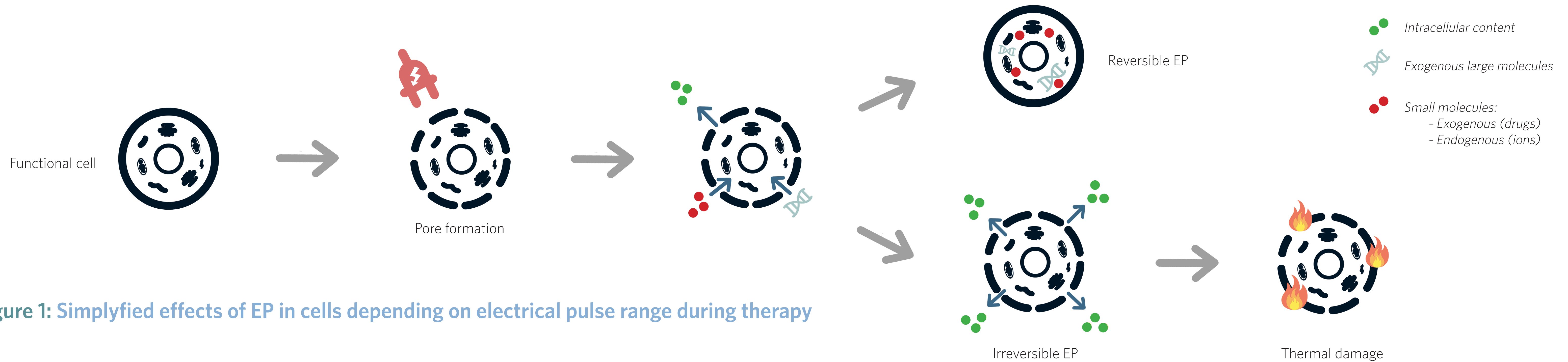
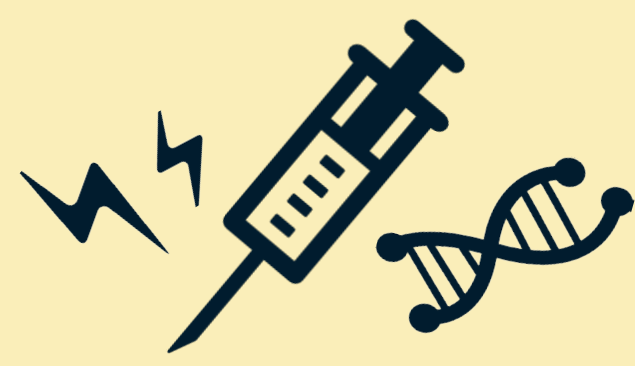


Figure 1: Simplified effects of EP in cells depending on electrical pulse range during therapy

## Applications of Electroporation

DNA  
(RNA)  
(Oligonucleotides)



### Gene Therapy (GET) and DNA immunization

- Cancer treatment, vaccinations, and metabolic or organ-specific diseases.
- Efficient in various tissues. Can improve muscle delivery up to 10,000-fold over naked DNA in both small and large animal species.
- Has been efficient as either a primary or booster vaccination strategy (Venezuelan Equine Encephalitis, Anthrax, and Influenza).

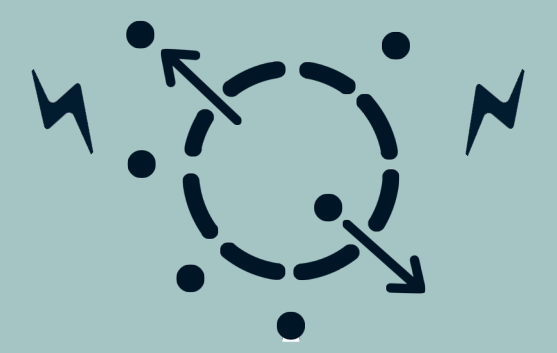
Bleomycin  
Cisplatin



### Electrochemotherapy (ECT): administration of an anticancer drug and local delivery of electrical pulses at the tumor site.

- Safe for different histological types and as an adjuvant treatment to surgery in companion animals and horses (Fig. 2).
- Approximately 80% long lasting objective response with minimal toxicity.

Higher voltage:  
permanent damage



### Nonthermal Irreversible Electroporation (NTIRE): it is an ablation method, leading to cell death either directly through excessive damage or via apoptosis. It spares the tissue scaffold, like large blood vessels and is usually employed in tumors.

- The efficacy of the procedure varies among studies and treated organs.

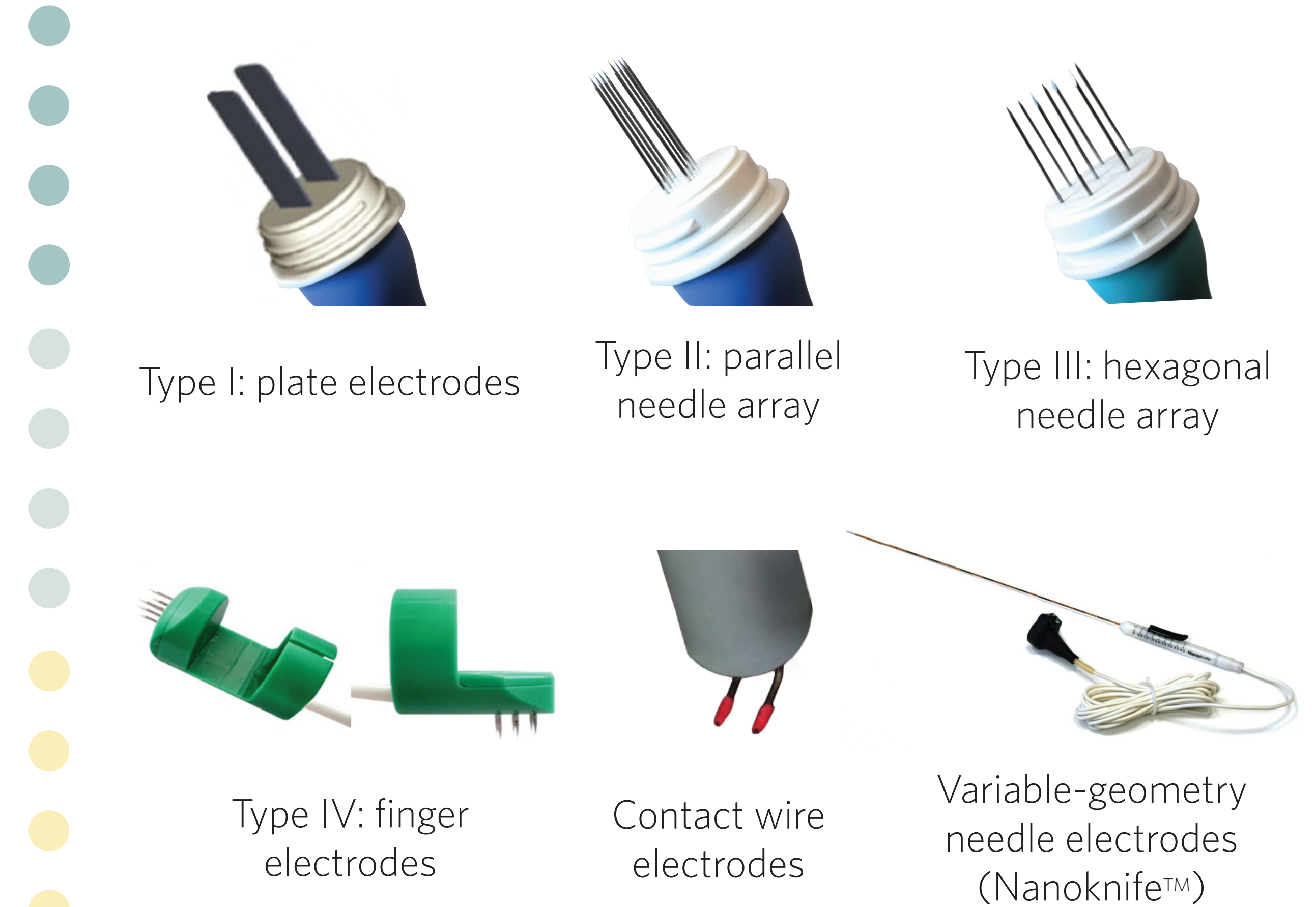
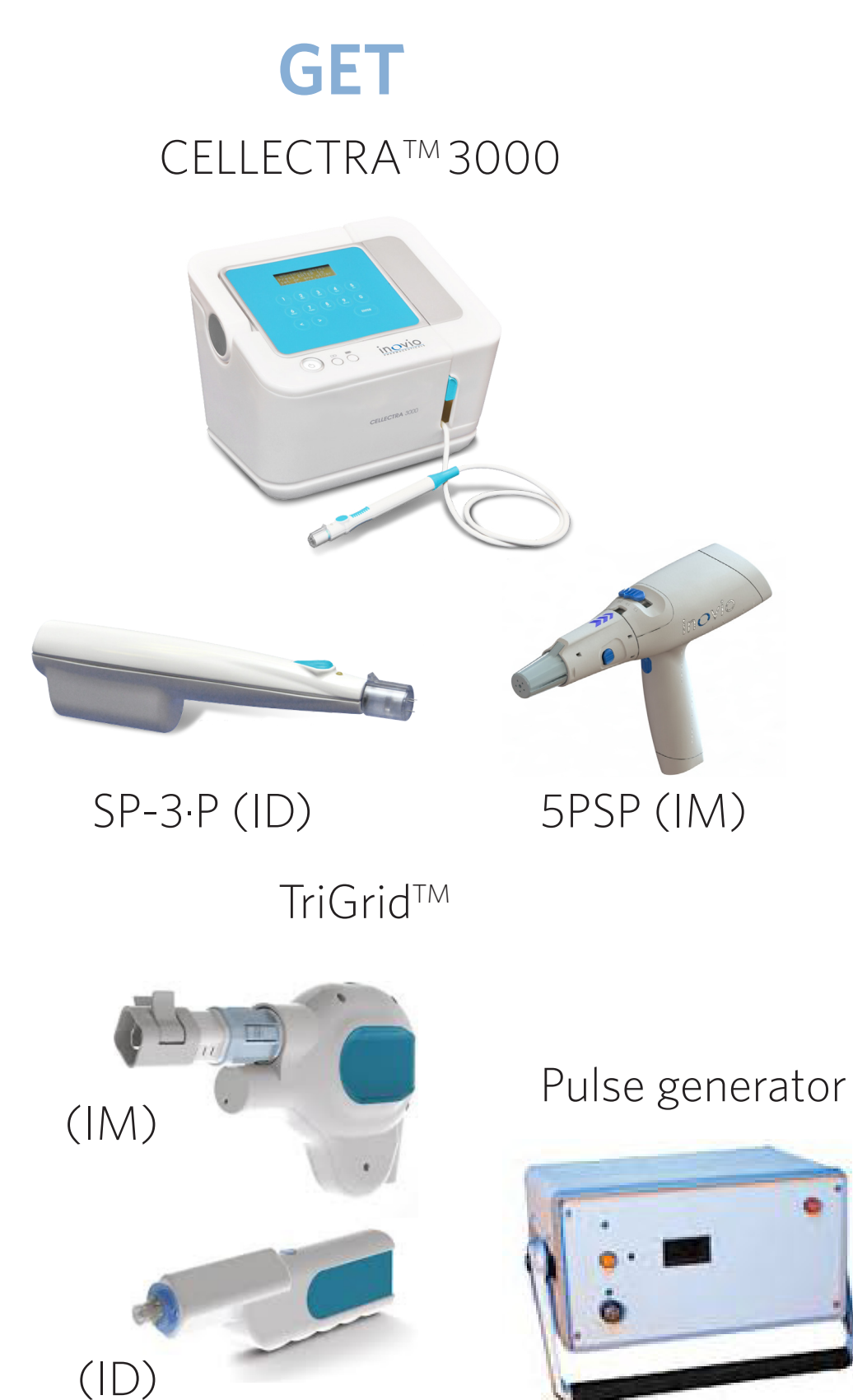


Figure 2: ECT treatment evolution in a 9-year-old gelding. Horse at presentation with 2 sarcomas on the left upper eyelid (left image), 2 weeks after 2nd ECT session (middle), and 18 weeks post 4th ECT (right). (Tamzali et al. 2012).

## Devices and Electrodes

ID: Intradermal IM: Intramuscular

All pictures below are extracted from the manufacturers' official websites.



## Conclusions

Electroporation can be expected to grow in the clinical practice use, as encouraging results have been reported in animal models and in several clinical trials using ECT, GET, and NTIRE. However, the inability to ablate some tumors and induce long-term immune protection with DNA vaccines must be clarified and overcome.

## Bibliography

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